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ABSTRACT

This paper discusses a study that compared enrollment patterns in advanced math and science courses of (n=720) junior and senior girls in public coed and parochial all-girls high schools in Louisiana. The study also examined survey responses regarding career goals and positive and negative career influences on girls. The same survey responses from (n=55) boys enrolled in advanced math and science courses at one of the coed public high schools were compared to the responses of both sets of girls. These survey responses indirectly indicated personality factors such as locus of control (instrumentality) and self-esteem. Findings include: (1) girls enrolled in advanced math and science courses seemed to have more positive self-esteem and an internal locus of control as well as strong parental support; and (2) a much larger percentage of girls at the all-girls schools were enrolled in chemistry, advanced biology, and advanced math classes, and a wider variety of advanced math and science courses was offered at the all-girls schools. Contains 21 references. (MKR)

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GENDER ISSUES AND THE MATH/SCIENCE CURRICULA: EFFECTS ON FEMALES

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The cultural underachievement of females has been reiterated for years by researchers (Stockard & Wood, 1984; Reis, 1987; Fuller, 1990). The discrepancy between the promising academic performance of gifted females and their subsequent talent development as indicated by actual adult accomplishments has been labeled by Olshen (1987) as the disappearance of giftedness in girls. Stockard and Wood (1984) note that the underachievement of females as measured by grades in school is a myth since girls' actual academic performance is consistent with their predicted ability. Instead, female underachievement is apparent in talent development, occupational attainment, and self concept as adults. According to Reis (1987), this phenomenon is evident in "bright women who do not achieve similar professional accomplishments as their male counterparts" (p. 84) and is reflected in "what a person believes can be attained or accomplished in life" (p. 84).

Perhaps the present status of women in the workforce "provides the best documentation for the argument that many gifted women are functioning as underachieving adults" (Davis & Rimm, 1989, p. 337). Despite the recent claims that more women are seeking traditionally male-dominated careers, the fact remains that women often occupy stereotypical roles and receive inequitable salaries and responsibilities (Davis & Rimm, 1989). A report by the Women's Bureau of the United States Department of Labor (1985) confirms this contention. The Women's Bureau notes that the top ten jobs for women are secretary, cashier, bookkeeper, registered nurse, waitress, elementary school teacher, nursing aid, sales supervisor, and typist. Dembart (1984) reports that, although female

scientists and engineers increased 200% between 1972 and 1982, women still represented only 3.5% of the two million American engineers and only 12% of the 225,000 physical scientists. According to Fuller (1990), although women represented 44% of the workforce in 1984, "they accounted for only 16% of all physicians and lawyers, only 6% of engineers, 5% of machinists, 3% of mechanics, and 1% of plumbers" (p. 19). The 1982 figures from the National Center for Educational Statistics, U.S. Department of Education, report a dramatic increase in the number of females receiving bachelor's and professional degrees in male-dominated fields. With the exception of health professions, however, the percentage of females is still much lower than that of males (Davis & Rimm, 1989).

Income percentage comparisons of female to male in 1986 were revealed as 77% for lawyers, 84% for engineers, 78% for computer systems analysts, 69% for physicians, and 62% for financial managers (Davis & Rimm, 1989). These figures suggest that education and training are not so important for upward mobility and high occupational attainment as is gender. Indeed, Wolleat (1979) contended that gender is the single best predictor of who will enter certain professions.

Gender differences have been attributed to biological, sociocultural, and natural ability factors. Results from a study concerning the attitudes of gifted girls and boys toward math showed that harmful stereotypical thinking regarding females and mathematics is evident as early as fourth grade (Cramer, 1989).

Controversy over the theory that males are innately superior in mathematical ability has been waged for several decades (Benbow & Stanley, 1983; Hall, 1980). The importance of the math differences hypothesis is related to the professional development of females because "male-dominated fields that convey high status and good financial rewards...*require skill in mathematics*" (Davis & Rimm, 1989, p. 353, emphasis in original).

One of the reasons for the differences in math achievement, especially with respect to the consistently lower math scores of females on the ACT/SAT, has been attributed to curriculum. A study by Pallas and Alexander (1983) revealed that SAT math performance is comparable between males and females who have had similar high school math courses. Similarly, research by Laing, Engen, and Maxey (1987) provides evidence that much of the variance in math ACT scores is accounted for by curriculum. These results suggest that "increasing females' enrollment in advanced math courses would reduce differences in SAT math performance" (Reis, 1987, p. 87).

Kerr (1991) reiterated this contention with the observation that "[g]ender differences in math scores generally begin at the point at which girls stop taking advanced math and science courses" (p. 405). There are a variety of reasons why girls do not take advanced math and science courses. One study found that teachers discourage females from taking advanced math courses (Fox, 1976). Too often, however, girls drop out of or do not enroll in advanced math and science courses because they are unaware that these courses are prerequisites for college majors leading to high level

professions (Kerr, 1985). Such a differential mathematics preparation "creates real barriers to the entrance of females into many male-dominated professions" (Davis & Rimm, 1989, p. 354). Thus, the inequity in the workforce begins with the inequity in the courses undertaken in high school.

Other factors which influence the underachievement of females are cultural ones, such as family, school, and peer expectations, which often discourage high achievement and/or career aspirations (Davis & Rimm, 1989). Personality and socialization factors include internal barriers such as self esteem and locus of control (Reis, 1987). Hollinger and Fleming (1988) indicate that social self esteem is central to the achievement issue and is the product of two self perceptions: instrumentality (self-assertiveness) and expressiveness (nurturance). A study by Hollinger (1983) revealed that androgynous females (those who scored high on instrumentality and expressiveness) also scored highest on social self esteem.

Other research has indicated that attendance at single sex schools seems to motivate many girls to assume leadership roles and to enroll in more advanced math and science courses (Tidball, 1973). A study by Wellesley College found that girls do better in all-girl settings (Massey, 1993). Furthermore, proportionally more eminent females have attended all-girls schools (Kerr, 1985). Reis (1987) suggested that further research is needed on the effect of single sex advanced math and science classes on the achievement of females.

The present study compared the enrollment patterns in advanced

math and science courses of girls in public coed and parochial all-girls high schools. The study also examined survey responses regarding career goals and positive and negative career influences on the girls. The same survey responses from boys enrolled in advanced math and science courses at one of the coed public high schools was compared to the responses of both sets of girls. These survey responses indirectly indicated personality factors such as locus of control (instrumentality) and self esteem.

Subjects were 720 junior and senior females in advanced math and science courses at the two types of institutions (coed public and parochial all girls) in Louisiana and 55 boys at one of the coed public high schools. The three largest parochial all girls schools were chosen from the greater New Orleans metropolitan area since a large proportion of high school students attend parochial, single sex schools. Five large public coed schools were randomly chosen from the Shreveport-Bossier area because the majority of high school students attend public coed institutions and there are no single sex schools. The counselors of these schools were instructed to administer the surveys to junior and senior girls enrolled in advanced math and science courses and to indicate the number of girls and boys enrolled in each advanced math and science course. Later, two of the public coed schools were asked to administer the same surveys to the junior and senior boys enrolled in advanced math and science courses so that comparisons could be made between males and females concerning career aspirations and positive and negative influences. Only one of the schools returned

the boys' survey responses.

Comparison of enrollment patterns in chemistry, advanced biology, and advanced math classes revealed that a much larger percentage of girls at the all girls schools was enrolled in these classes and that a wider variety of advanced math and science courses was offered at the all girls schools. Specifically, 100% of the juniors at the all girls schools were taking or had taken chemistry compared to 32% of the coed junior girls; 75% of the all girls seniors were taking or had taken physics compared to 10% of the coed senior girls; and 23% of the all girls seniors were taking advanced biology compared to 3% of the coed senior girls. At one coed public school, advanced biology was not even offered. At the all girls schools a variety of advanced math courses was offered (trigonometry, precalculus, calculus, advanced math), while only one course entitled advanced math was available at the coed schools. Specifically, 73% of the all girls seniors were taking an advanced math class, while only 17% of the coed senior girls were taking an advanced math class. These descriptive statistics indicate rather pointedly that the graduates of the all girls schools will have an advantage over their coed peers in that more career paths will be available to them in college. This rather large disparity suggests that counselors and school administrators at the coed public high schools should actively recruit more females into the advanced math and science classes, especially basic courses such as chemistry and physics, which are the prerequisites for many high paying, prestigious occupations.

Survey questions to which the subjects responded concerned their top three career choices, the reason they were taking or had taken advanced math and science courses, both the greatest positive and negative influences on their academic/career goals, and any obstacles they perceived to their academic/career goals. The girls' responses to the survey questions were surprisingly similar at the two types of institutions.

The top five career choices at the all girls schools were teacher (22%), nurse (21%), psychologist (20%), doctor (18%), physical therapist (16%). (Engineer was sixth with 12%.) The top five career choices at the coed public school were quite similar: nurse (28%), physical therapist (24%), lawyer (22%), doctor (18%), while teacher (16%) and accountant (16%) tied. It is significant to note that not one female desired to become a housewife, and that the overwhelming majority of girls at both types of schools chose professional careers which require a minimum education of a college degree. While the occupations of teacher and nurse are traditional feminine roles, nursing is a highly paid, highly respected profession. Furthermore, as Gilligan (1982) asserted, the female value system includes the ethic of caring, thus leading many to the helping, nurturing, service-oriented professions.

The top five career choices of the junior and senior boys enrolled in advanced math and science courses were more technical and business oriented: engineer (35%), doctor (24%), lawyer (19%), and a tie between accountant (17%) and business (17%). Although physical therapist (15%) was a not too distant fifth choice, nurse

was mentioned by only six students and teacher by only three.

When asked why they were taking or had taken advanced math and science courses, many of the girls gave multiple responses. Since chemistry was required at the three all girls schools and physics was required at two of the all girls schools, the number one reason given by subjects at these schools was that the courses were required (68%), followed by preparation for college/ career (38%), and personal interest (28%). The top four reasons given by subjects at the coed schools were preparation for college/career (63%), personal interest (21%), required (18%), and challenging (10%). While more of the girls at public coed high schools enrolled in these courses in preparation for college/career, they represent only a small percentage of females at the coed institutions. Thus, although these particular females may be more aware of requirements for career goals, the majority of coed females either are not aware of or do not have high career aspirations because they are not taking such courses.

When asked why they had enrolled in these advanced math and science courses, responses given by junior and senior boys were similar to the the girls' responses: preparation for college/ career (72%) and personal interest (11%), while teacher advice (6%) and college entrance exams (6%) tied as a distant third choice.

When asked to name the greatest positive influence on academic/career choices, girls from the two types of institutions gave identical responses. The top four responses at the all girls schools were myself (29%), parents (16%), mother (13%), and

teacher(s) (10%), while the top responses at the coed schools were myself (26%), parents (20%), mother (19%), and teacher(s) (15%) and other family members (15%) tied. Combining the responses of parents, mother, and father, parental influence was 35% at the all girls schools and 42% at the coed schools. These response patterns seem to indicate an internal locus of control and strong parental support. Also of interest was that a small percentage (6% at all girls schools; 3% at coed schools) mentioned their father specifically as the greatest positive influence.

When asked to name the greatest positive influence on academic/career goals, the boys gave almost identical responses as the girls: myself (28%), parents (22%), teacher(s) (13%), and friends (11%). Combining the responses of parents, mother, and father, parental influence was 37% for the boys.

When asked to name the greatest negative influence on academic/career goals, the girls again gave similar responses. The top responses at the all girls schools were no one/nothing (28%), difficult academic road ahead (7%), and teacher(s) (6%). Top responses at the coed schools were no one/nothing (39%), friends (10%), and teacher(s) (8%). The fact that the overwhelming number one response at both types of institutions was no one/nothing seems to indicate an internal locus of control among the girls. One possible explanation for the fact that friends seem not to exert a negative influence on the girls at the all girls schools is the absence of boys at these schools. Girls at single sex schools tend to think mainly of other girls as friends, while girls at coed

schools tend to think of both sexes as friends.

When the boys were asked to name the greatest negative influence on their academic/career goals, they again gave almost identical responses as the girls: no one/nothing (33%), friends (11%), and teachers (9%).

When asked to name possible obstacles to their academic/career goals, the girls again gave similar responses. The top responses given by girls at the all girls schools were finances (27%), difficult college courses (15%), college admission requirements (14%), self discipline (13%), and none (11%). The top responses given by coed girls were finances (27%), none (19%), difficult college courses (13%), college admission requirements (13%), and self discipline (11%). A small percentage (2% at both types of schools) acknowledged the possibility of sexist barriers in society, and a few expressed concern over the problems of balancing the responsibilities of career and family.

What was refreshing was the large number of females who made positive statements to the effect that they could achieve their goals with determination and hard work. Those who recognized sexist barriers were likewise optimistic that such barriers might make their goals more difficult but not impossible to achieve. Discouraging were statements indicating that family members exerted negative influences. A statement from a girl at a coed school illustrates what attendance at an all girls school succeeds in avoiding: "A lot of guys make females feel insecure. They think we can't do it." Most of the females enrolled in advanced math and

science courses at both types of institutions, however, seemed to indicate an attitude of self confidence in their ability.

When asked to name possible obstacles to their academic/ career goals, the boys again gave similar responses to those of the girls: finances (19%), none (17%), difficult college courses (13%), and self discipline (9%). The national and local economies undoubtedly influenced the responses of all subjects, both males and females. All responses are summarized in Table 1.

Insert Table 1 About Here

What was rather surprising was the similarity of responses (with the notable exception of career aspirations) among all respondents, regardless of both sex and institutional setting. In conclusion, the girls enrolled in advanced math and science courses seem to have a more positive self esteem and an internal locus of control as well as strong parental support. In fact, these same characteristics are evident in the boys enrolled in advanced math and science courses. More research needs to be done on androgynous characteristics (self assertiveness and nurturance) among girls enrolled in advanced math and science courses.

It is significant that the female responses, however similar to each other and to the boys, represent only a small percentage of girls at coed schools, while they represent the majority of girls at all girls schools. More research needs to be done on the females in coed schools who do not enroll in advanced math and science courses or even in basic science classes such as chemistry

and physics. Counselors, teachers, and school administrators in public coed high schools should encourage more girls to enroll in these classes because the failure to do so closes the window of opportunity to many of them.

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Table 1

Summary of Survey Responses

Top Five Career Choices

All Girls		Girls/Coed		Boys/Coed	
Teacher	22%	Nurse	28%	Engineer	35%
Nurse	21%	Physical Therapist	24%	Doctor	24%
Psychologist	20%	Lawyer	22%	Lawyer	19%
Doctor	18%	Doctor	18%	Accountant & Business	17%
Physical Therapist	16%	Teacher & Accountant	16%	Physical Therapist	15%

Reasons for Enrollment in Advanced Math & Science Courses

All Girls		Girls/Coed		Boys/Coed	
Required	68%	College/Career Prep.	63%	College/Career Prep.	72%
College/Career Prep.	38%	Personal Interest	21%	Personal Interest	11%
Personal Interest	28%	Required	18%	Teacher Advice/ College Entrance	6%
		Challenging	10%		

Greatest Positive Influence on Academic/Career Choices

All Girls		Girls/Coed		Boys/Coed	
Myself	29%	Myself	26%	Myself	28%
Parents	16%	Parents	20%	Parents	22%
Mother	13%	Mother	19%	Teachers	13%
Teachers	10%	Teacher/Family Members	15%	Friends	11%

Greatest Negative Influence on Academic/Career Choices

All Girls		Girls/Coed		Boys/Coed	
No one/Nothing	28%	No one/Nothing	39%	No one/Nothing	33%
Difficult Academic Road	7%	Friends	10%	Friends	11%
Teachers	6%	Teachers	8%	Teachers	9%

Possible Obstacles to Achieving Academic/Career Goals

All Girls		Girls/Coed		Boys/Coed	
Finances	27%	Finances	27%	Finances	19%
Diff. College Courses	15%	None	19%	None	17%
College Admission Req.	14%	Diff. College Courses	13%	Diff. College Courses	13%
Self-Discipline	13%	College Admission Req.	13%	Self-Discipline	9%
None	11%	Self-Discipline	11%		